Nano.gov
U.S. National Nanotechnology Initiative

Nanotechnology Signature Initiative*
Nanotechnology for Solar Energy Collection and Conversion

Overview

Solar energy is a promising energy source that has the potential to reduce U.S. dependence on fossil fuels. New innovations and fundamental scientific breakthroughs are required, however, to accelerate the development of solar energy technologies that are economically competitive with conventional fossil fuels. Agencies participating in the NNI have identified a number of physical phenomena where nanotechnology may play a critical role in overcoming current performance barriers to substantially improve the collection and conversion of solar energy. Certain engineered nanomaterials and nanostructures have been shown to enhance the absorption of light, increase the conversion of light to electricity, and provide better thermal storage and transport. Nanostructured artificial photosynthetic systems mimicking those found in nature will be important for the conversion of solar energy into chemical fuels. A deeper theoretical understanding of conversion and storage phenomena at the nanoscale, improvements in the nanoscale characterization of electronic properties, and developments that enable economical nanomanufacturing of robust devices will be critical to exploiting the benefits of nanotechnology for solar energy. Product lifetime and reliability of technologies incorporating nanotechnology must also meet or exceed the performance of conventional solar technologies.

Goals

Enhance understanding of conversion and storage phenomena at the nanoscale, improve nanoscale characterization of electronic properties, and help enable economical nanomanufacturing of robust devices.

Thrust Areas

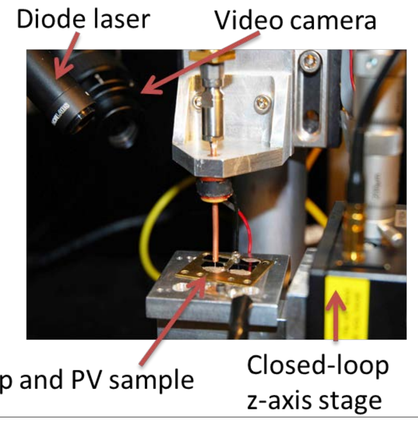
- Improve photovoltaic solar electricity generation
- Improve solar thermal energy generation and
- Improve solar-to-fuel conversions with nanotechnology

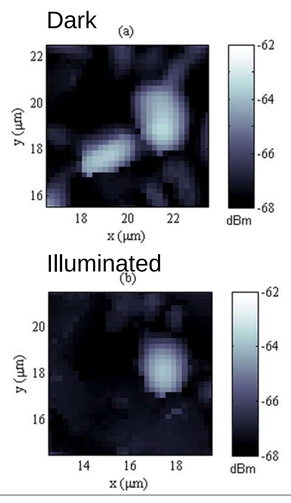
Agencies Involved

Department of Commerce (National Institute of Standards and Technology), Department of Defense, Department of Energy, the Intelligence Community, National Aeronautics and Space Administration, National Science Foundation, and U.S. Department of Agriculture (National Institute of Food and Agriculture).

Examples of Activities that Support the Goals of the Solar NSI

NIST Near-Field Scanning Microwave Microscopy

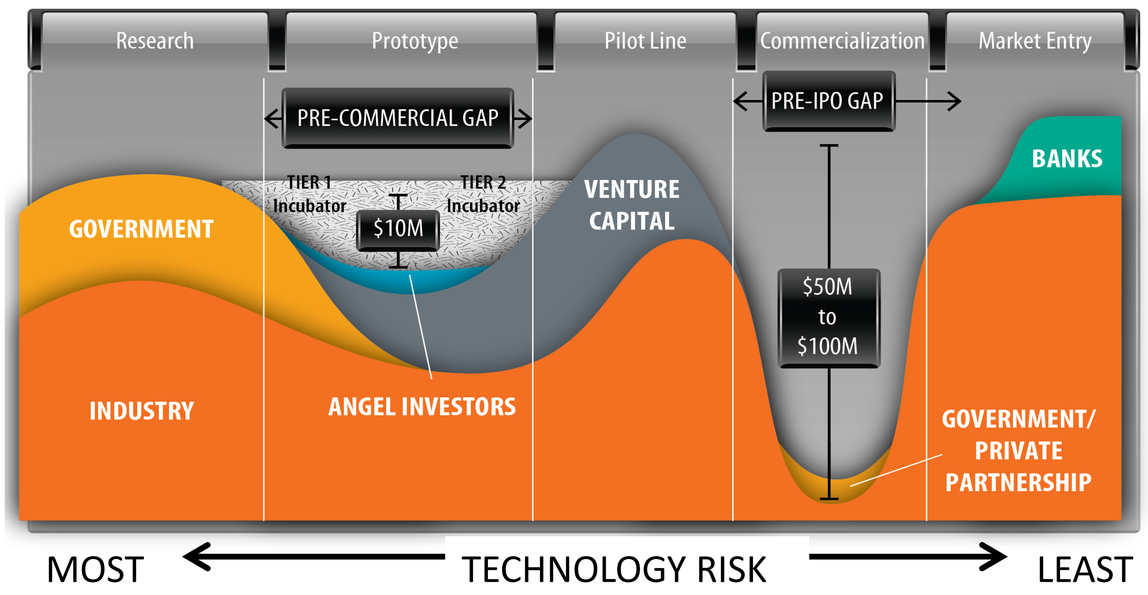




Examples of Activities that Support the Goals of the Solar NSI

DOE SunShot Incubator Supports Startups

SunShot U.S. Department of Energy



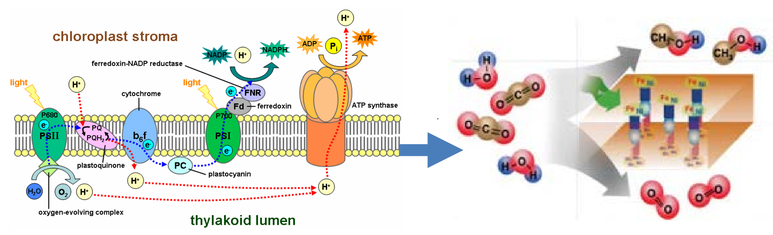
Goals:

- Integrate Si nanowire cells into standard processing techniques to increase solar cell efficiencies by ~10%
- Provide nanowire-coated wafers to cell manufacturers and cooperatively develop the fully integrated manufacturing process

LOAN GUARANTEE PROGRAM

DOE Office of Science

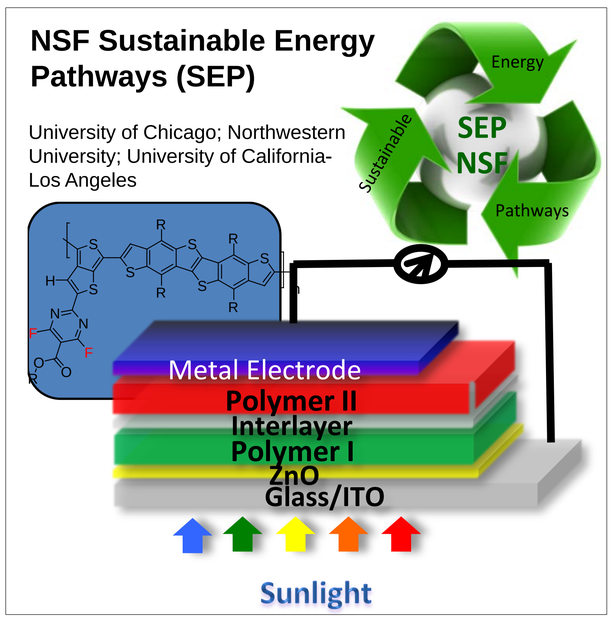
Fuels from Sunlight Energy Innovation Hub: Joint Center for Artificial Photosynthesis (JCAP)



JCAP Partners:
Caltech, LBNL, SLAC, UC-Irvine and UC-San Diego.

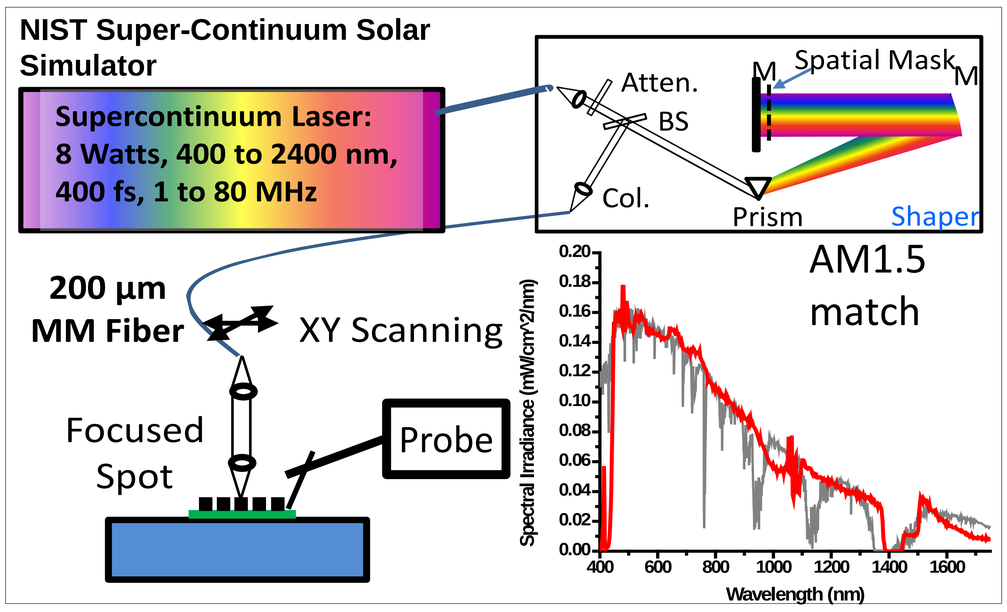
NSF Sustainable Energy Pathways (SEP)

University of Chicago; Northwestern University; University of California-Los Angeles

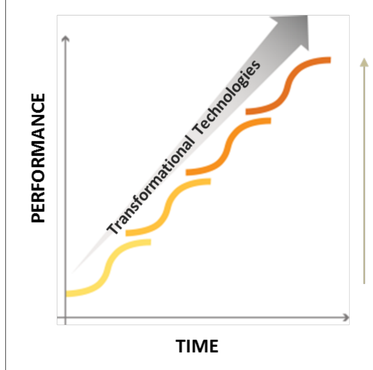


NIST Super-Continuum Solar Simulator

Supercontinuum Laser: 8 Watts, 400 to 2400 nm, 400 fs, 1 to 80 MHz



DOE/NSF Next Gen Photovoltaics II



- Exceeding the Shockley-Queisser limit
- Overcoming the Staebler-Wronski effect
- Advancing light trapping
- Novel earth-abundant PV materials

* Nanotechnology Signature Initiatives (NSIs) are topical areas identified by the National Nanotechnology Initiative and its agencies as benefiting greatly from close and targeted interagency interactions. The NSIs spotlight key areas of national priority and provide a mechanism for enhanced collaboration to leverage research and development programs across multiple agencies.

For more information, contact the National Nanotechnology Coordination Office (NNCO) at info@nnco.nano.gov
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